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Towards ambitious teaching: using video to support future teachers reasoning about evidence of student learning

Vers un enseignement ambitieux : l'usage de la vidéo pour soutenir le développement du raisonnement des futurs enseignants au regard de preuves concernant l'apprentissage des élèves

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Towards ambitious teaching: using video to support future teachers reasoning about evidence of student learning

Voir résumé long en français à la fin de l'article

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ABSTRACT: This article discusses systematic analysis of teaching as a process to prepare future teachers to plan, teach, and reflect on their teaching. The process includes four practices: 1) specifying the lesson learning goals for students; (2) conducting empirical observations to collect evidence of student learning; (3) generating hypotheses about features of the teacher's instruction that promoted student learning; and (4) revising instruction on the basis of these hypotheses. Studies that used this process in the context of teacher preparation programs are reviewed. Finally, a case is presented as an illustration of ways analysis skills are used in practice and as an argument that these skills may position pre-service teachers on a trajectory for continuous improvement.

KEYWORDS: initial teacher education, mathematics, audiovisual equipment

1. Introduction

Recent research on teacher knowledge in the United States has included a focus on teachers' professional vision. Like professionals in other fields, teachers develop a specialized way to process information generated through their jobs and learn to make sense of this information to make decisions and complete their daily tasks. Professional vision for teachers has been defined to include two processes: (1) attending to important elements of instruction, and (2) reasoning about these elements to make sense of what is happening in the classroom and to make decisions about next steps (Sherin, 2007). While this initial definition of teacher professional vision focused on teacher processing of information in the midst of teaching, what happens in the classroom is only a component of the teaching profession.

Although initial research on professional vision has built on the original definition and has focused on teacher noticing during instruction, the field has more recently included studies of teacher professional vision as it is applied before and after teaching. Teachers plan classroom activities every day and reflect (in more or less systematic ways) at the end of each teaching day. Planning and reflection are very important tasks in the job of teaching because they impact teacher decisions in the classroom. A recent study found that teachers' ability to analyze a teaching episode portrayed in a video clip and to propose suggestions for instructional improvementpredicts teacher effectiveness as measured by student learning (Kersting, et al., 2012). In other words, teachers who are able to attend to important elements of instruction, to identify what is problematic, and to plan for an alternative instructional strategy (based on a clear defined hypothesis of its benefits for student learning), are more effective teachers. Although teachers in this study analyzed somebody else's teaching, it is plausible that they are capable of applying these skills to their own teaching as well.

These findings have important implications for teacher preparation. Novice teachers need not only to know the subject matter they teach and the pedagogical strategies that foster student learning, they also need to know how to plan for instruction and how to reflect on the effectiveness of their teaching strategies so they can make decisions about next steps. Planning and reflection have long been considered important aspects of the job of teaching. What is innovative in the current research on teacher preparation is attention to *systematic* planning and reflection processes and the need to teach these processes to future teachers.

In the next section, I will discuss in detail the process of analysis I have been promoting in my work with pre-service teachers and teacher educators, ways I have used video to support pre-service teachers' learning process, and the findings of a few of the research projects I have conducted. I will then illustrate what the ability to systematically analyze teaching might look like through the review of teaching and analysis produced by a pre-service teacher who participated in a recent project. I will conclude with a discussion of issues teacher educators should consider when using video in teacher preparation and a reflection on the long-terms benefits of analysis skills.

2. Systematic Analysis of Teaching

In 2007, Hiebert, Morris, Berk, and Jansen published a seminal piece on "preparing teachers to learn from teaching." In that article, they proposed four skills that pre-service teachers need to master to be able to analyze teaching effectively. The authors argue that mastery of these skills allows pre-service teachers to continue to learn from and improve their practice over time and to continue to learn as they enter the teaching profession. These four skills are: (1) specifying lesson learning goals for students; (2) conducting empirical observations to collect

evidence of student learning; (3) generating hypotheses about features of the teacher's instruction that promoted student learning; and (4) revising instruction on the basis of these hypotheses.

2.1. Specifying Lesson Learning Goals

The ultimate goal of any teaching act is for students to learn what the teacher had intended to teach. Most teachers begin a lesson with a learning goal for their students. Often this learning goal is broad and is described in terms of what students will be able to do, with little attention to the key ideas that students need to understand to be able to succeed in a task. Broadly-defined goals lead teachers to assess students as being either right or wrong. No information is available on what specifically students need to understand and learn and how they can make gradual progress towards a learning goal. Goal specification is thus extremely important, if we want teachers to pay attention to the subcomponent or key ideas of the topics they teach (Morris, Hiebert, & Spitzer, 2009). When teachers specify these subcomponents, they are more likely to analyze student performance beyond right and wrong and assess student learning in ways that identify both student mastery and difficulty with specific subject matter ideas (Berk& Hiebert, 2009). Take for example a lesson on subtraction. A teacher could phrase the lesson learning goal as: students will be able to solve a variety of subtraction word problems. Theteacher could specify the goal further: students will be able to interpret subtraction as both the removal of a smaller quantity from a larger quantity, and as a comparison of a smaller quantity to a larger quantity (Berk& Hiebert, 2009). These two goals will inevitably lead to different observations and assessment of student learning.

2.2. Conducting Empirical Observations to Collect Evidence of Student Learning

Once the learning goal has been specified, teachers can collect different forms of evidence to assess whether students made progress towards the goal. Evidence of student learning can come from different sources, such as student written work and discourse. What is importantfor the analysis process to be effective is that the evidence collected must be (1) focused on what students were able to demonstrate (and not on what the teacher did effectively); and (2) relevant to the learning goal of that instructional episode (and not relevant to other learning goals not targeted in that episode). A common error is for teachers to attribute conceptual understanding to students when the evidence they collected is only about procedural fluency (Bartell, Weben, Bowel, & Dyson, 2012). In addition, teachers need to know how to collect evidence and to plan for the collection of multiple sources of evidence, so their claims of teaching effectiveness can be stronger.

2.3. Generating Hypotheses about Features of the Teacher's Instruction that Promoted Student Learning

This skill involves the ability to make claims about features of instruction that promoted student progress towards the learning goal. This skill is strongly tied

to the previous two as claims that lead to improvements in teaching are focused on students' progress towards the stated learning goal and are based on relevant evidence. Without a strong foundation in the previous two skills, teachers are likely to make claims that are unjustified and based only on assumptions they have about the effectiveness of certain instructional strategies rather than on evidence of student learning.

2.4. Using Hypotheses to Propose Improvements in Teaching

Once teachers have generated learning-goal oriented and evidence-based hypotheses, they are ready to propose improvements in teaching. In other words, they are ready to make decisions about features of instruction they want to maintain and features they want to change. This is an important step in the process because it links the systematic analysis of teaching and learning to subsequent action. As mentioned earlier, a study involving practicing teachers found that the teachers who were able to propose improvements had more impact on their students' learning than teachers who didn't (Kersting, et al., 2012).

3. Analysis Skills and Ambitious Mathematics Teaching

The process of systematic reflection on teaching outlined above is promising for improving classroom instruction as it is aligned with current reform-minded teaching practices(National Governors Association for Best Practices, 2010). In the U.S., scholars have come to use the term "ambitious mathematics teaching" to characterize a reform-minded approach to mathematics teaching that places students at the center of the teaching and learning process (McDonald, Kazemi, & Kavanagh, 2013). Teachers carefully craft instructional activities to engage students with key mathematical ideas. They create opportunities for students to discuss solution strategies and mathematical conjectures, and student thinking is constantly built upon to move the lesson forward.

While engaging in the analysis process described above, teachers: (a) develop dispositions, knowledge, and skills for attending to the details of students' mathematical thinking and (b) learn about instructional strategies that make student thinking visible and build on student thinking to develop mathematical understandings. Initial evidence I have gathered in two different projects leads me to believe that pre-service teachers, who have developed analysis dispositions and skills, adopt teaching practices that are more aligned to ambitious math teaching than pre-service teachers who have not been exposed to systematic analysis of teaching (Santagata, 2013; Santagata & Yeh, 2013).

4. Lesson Analysis Framework and the Use of Digital Video

In my work on teacher preparation, I have used a framework to guide pre-service elementary (teaching students from 5 to 11 years of age) and secondary (teaching

students from 12 to 18 years of age) teachers in the systematic analysis of teaching and to provide opportunities for them to practice the four skills and receive feedback on their progress (Santagata & Angelici, 2010; Santagata & Guarino, 2011). This framework –the Lesson Analysis Framework– is centered on four questions:

(1) What is the main learning goal of this lesson (or instructional episode)?
(2) What progress did students make toward the learning goal? What difficulties did they encounter? What evidence is missing?
(3) Which instructional strategies helped students make progress toward the goal? Which did not?
(4) What alternative strategies should the teacher try and how will these impact students' learning?

The Lesson Analysis Framework is at the core of a series of activities that we have designed in our teacher preparation program to develop the skills described above. Most of these activities use video to represent teaching and learning situations. One of the advantages of using video is that it portrays teaching in its complexity and allows pre-service teachers to acquire analysis skills in the context of real teaching situations. Another advantage is that in contrast to live observations, video (in digital format) allows viewers to slow down the teaching process by stopping and reviewing images when needed. This facilitates a level of analysis not possible during live observations or in the midst of teaching. While teachers don't have the time to analyze their practices through video after each lesson they teach, video-based analysis is a powerful learning tool in teacher preparation and professional development settings. Research shows that the eyes of teachers trained through video, see differently also in the absence of it. In other words, once teachers develop analysis skills in the context of video-based professional development settings, these become the lenses through which they think about and reflect on their practices every day (Sherin & van Es, 2009).

The choice of video depends on the learning goal of each activity we have designed. We work on pre-service analysis skills in the context of the mathematics methods course (although we plan to extend this work to other subject matters). We begin our methods course with videos that portray interviews with individual students solving math tasks and being questioned about their solution strategies and their thinking. We use these videos to help pre-service teachers appreciate the complexity of children's mathematical thinking, to learn about children's mathematical understandings, and to acquire effective questioning skills. We then use videos of episodes of classroom lessons, sometimes accompanied by sample of student work, to analyze learning goals, evidence of student progress towards the goal, evidence of student difficulties and misconceptions, and specific instructional strategies. These videos initially portray experienced teachers and are drawn from publicly available videos of classroom lessons. In addition to providing a sharedreference for developing pre-service teachers' analysis skills, video also provides examples of reform-based teaching strategies to which pre-service teachers are often not exposed. Because our ultimate goal is for pre-service teachers to learn

to apply analysis skills to their own practice, we also require that they videotape themselves and analyze their teaching in light of the Lesson Analysis framework questions. All these activities include feedback we provide either to the whole group during class discussions or individually in the form of notes on pre-service teachers' written analyses.

These video-based activities have been proven to be successful. Over the years, in collaboration with different scholars, I have conducted a series of studies that, as a whole, provide evidence that both elementary and secondary pre-service teachers can acquire analysis skills during teacher preparation (Santagata, Zannoni, & Stigler, 2007; Santagata & Guarino, 2011). These studies also document the process of learning and highlight that only systematic instruction on these skills leads to significant improvements (Santagata & Angelici, 2010; Santagata, Jovel, &Yeh, under review). While I direct the reader to the above publications for details on pre-service teacher learning outcomes, I here illustrate through an example what analysis skills might look like and why the ability to conduct an effective analysis of practice may position a pre-service teacher on a trajectory for continuous improvement.

4. The Case of Anna

Anna attended a one-year, post-bachelor teacher preparation program at my institution. Anna was also a participant in the "Learning to Learn from Mathematics Teaching" project. This is one of the studies I mentioned above and it involved approximately 60 pre-service elementary teachers in a mathematics methods course that combined instruction on pedagogies specific to elementary-school mathematics teaching with video-enhanced systematic analysis and of teaching. During the duration of the methods course (20 weeks), Anna was a student teacher in a second-grade classroom (the third year of elementary school in the U.S.; children are 7-8 years old). Like all students in our program, Anna had to complete the Performance Assessment for California Teachers (PACT) in order to graduate and receive her teaching credential. As part of the PACT, Anna taught 3 lessons on place value and turned in two brief clips from her second lesson (for a total of 15 minutes of footage). Along with the video file, Anna also turned in a lesson plan, assessments, samples of student work, and a series of written reflections on her lessons. I'll review sections of the material Anna submitted in light of the four skills for analyzing and learning from teaching described above. Anna's lesson plan includes the following learning goal for students:

> *The students will be able to recognize the need to "trade up" or "trade down" place value manipulatives or diagrams when adding or subtracting 1, 10, or 100 to a given number (i.e. when subtracting 1 from 70, students will need to "trade down" 1 ten for 10 ones then take away 1 one) and write the new number in its standard form.*

In the first video clip Anna submitted, we see her introduce the lesson by reviewing the meaning of ones, tens, hundreds, and thousands. Anna uses virtual blocks on a SmartBoard and, through questions addressed to the whole class, discusses how many ones are needed to make a ten, how many tens to make a hundred, and how many hundreds to make a thousand. In the second clip, Anna presents students with various configurations of blocks (using hundreds, tens, and ones) to represent numerical valuesand asks students to predict how many trades they will need to perform and what digit will change and why. Following is a sample interaction Anna has with her students. The SmartBoard screen shows 2 hundreds, 11 tens, and 12 ones. A student, Katherine is asked to come to the board to perform the trades and another student, Nico, is asked to predict how many trades she will need to do.

Teacher: Alright, Nico, what do you- what do you predict? How many trades will Katherine have to do?

Nico: Three.

Teacher: Three, and why three Nico?

Nico: Because ( ) more than ten, so you add ten, but and that's going to be more than, because that's going to be more than a hundred so you make a hundred flat. ( )

Teacher: So Nico says that he- he predicts that there will be three trades. Thumbs up if you agree with Nico, thumbs down if you think you have a different number. Rose, you said you don't agree with Nico, so how many trades do you-

Rose: Two.

Teacher: Two, why two?

Rose: Cause – cause there's only – there's only a couple (inaudible).

Teacher: Okay, so what did you do next?

Rose: ( ).

Teacher: Alright so Katherine just threw away ten ones, and now she's exchanging it for one ten rod. And then what're you going to do next? Katherine- uh let's see. Joshua, what is Katherine doing right now?

Joshua: She is exchanging the tens, because there is um- over um ten, ten rods and so she can trade it in for a hundred.

The lesson continues with Anna asking students to add or subtract a one or a ten from various numbers (i.e., 389 + 1; 209 - 10). In her lesson commentary Anna explains:

When we started talking about how adding just one to 388 then one more to make 390, I had students discuss with a partner to allow them the opportunity to voice their thoughts out loud. This approach helped further students' knowledge as I just added one to 388 in order to see if students know what

digit is affected without any transitions in the ones and tens place. Once it was evident that they knew how the ones digit is affected when adding 1 without transition, I began to push their understanding by having them think and discuss what changes when adding one more to 9 ones.

This phase of the lesson is followed by a game, "Trade Up Trade Down." Students practice in pairs adding or subtracting 1, 10, or 100 to their base-ten manipulatives on a place value mat by rolling a + or - 1, 10, 100 die. Similarly to the SmartBoard activity, the game focuses on transitional points in which students have to add or subtract then exchange ones, tens, or hundreds (for example, subtracting 1 from 10 and exchanging for 9 ones). In addition, students are asked to predict a die roll combination that will take from a given number to another (for ex. from 402 to 1,000).

When asked to provide evidence that students reached the lesson learning goal, Anna cites evidence of students' progress from various parts of the lesson. In relation to the "Trade Up Trade Down" game, Anna states:

During the game many of the students showed that they met the learning goal as one student was seen with 8 tens and rolled "-1". She put a ten rod away and took out 9 one cubes and placed them on her mat, thus showing her understanding of the trade up and trade down process for place value. When students were stopped to make a prediction of rolls from 402 to 1,000 the few students who were called were able to describe a roll combination that could get to 1,000. As the students are able to predict the rolls, they were able to show that they have met the goal of understanding place value's role in building numbers and the chance of trading numbers up and down.

When asked to discuss how her instructional choices assisted students in making progress towards the lesson learning goal, Anna writes:

For the intro/reassessment I chose one number set that involved one trade then another number set that involved two trades. I constantly asked students to prove their own or their peers' answers. As they explained their responses they were able to reason and gain depth in their understanding. For the body of the lesson, I decided to start with the number 388. When I added one I wanted to see if they understood that only the ones digit changed. Once they saw this, I knew I could add another one to check their understanding of trading up. Once the students showed understanding of trading upI knew that I could get into numbers involving trading down. Before showing the answer to taking away one from 220, I had students walk around and tell a peer their prediction about what digits were going to change. Having them talk to their partner allowed time for them to structure their thoughts and check for understanding.

When asked to provide examples of students who struggled, Anna describes in detail mistakes that she observed her students make when working on their place value mat.

One student was spotted with more than 10 ten rods on her place value mat thus showing her inability to recognize that a possible trade could be made as she continued to build on the amount of tens she earned. Also, there was a moment

when a student had 8 ten rods on her mat. She rolled "-1" and took out an entire ten rod off her mat.

These mistakes signaled to her that a few students were still struggling with the concept. In response to these struggles, Anna suggests instructional improvements for her lesson:

> *There is a concern that as I had students give thumbs up or down, a few students may look for what gesture is being used by a majority of the class. It is definitely a missed opportunity not to have students write their responses on the board or place their hand below their chin (where responses by other peers aren't as obvious) in order to have a better gauge of their understanding during the lesson. Another missed opportunity was not challenging students to create another prediction of rolls for the same set of numbers from 402 to 1,000. This would have helped to see if students were able to see the flexibility in numbers, as they were able to come up with various roll combinations including both adding and subtracting.*

At the end of the PACT assessment, pre-service teachers are asked to comment on what they have learned about their students' mathematics learning through the teaching and reflection process. Anna's answer is too long to quote in its entirety here, but among the things she lists are:

> *Students were using similar explanations previously shared by their peers to show their own thinking.*
>
> *They are easily able to identify the parts of a given number in its simplest, most efficient representation with the least amount of hundreds, tens, and ones used. Some still did show struggle with showing a number in a second way requiring a strong understanding of number flexibility.*
>
> *Students show that they do still need some support in how to use the academic language in their own discourse*

5. Discussion

In considering Anna's case, I would like to take the reader back to the four skills that characterize the learning from teaching process and review Anna's teaching, planning, and reflection in light of the four skills.

5.1. Specifying Lesson Learning Goals

Anna's learning goal as stated in her lesson plan is specific in terms of what she wants her students to be able to do by the end of the lesson, but it is less specific about what she wants them to understand. The only reference to a higher-level cognitive process is the phrasing, "The students will be able to recognize the need to "trade up" or "trade down" place value manipulatives." Implicit in term "recognize the need" is that students' understanding of place value will prompt them to perform the trade-up or trade-down trades correctly. Nonetheless, Anna seems to be driven by a specific learning goal when she provides evidence of student progress and student difficulties. Her choice of tasks and her rationale for a particular

task sequence also demonstrate understanding of the concepts students need to master to solve the problems. As noted earlier, the ability to specify a learning goal is extremely challenging, thus Anna's conception of the learning goal is pretty advanced for a novice.

5.2. Conducting Empirical Observations to Collect Evidence of Student Learning

When asked to provide evidence of student progress and struggle, Anna focuses on what students were able to demonstrate and found difficult. Novice teachers tend to focus on their instructional strategies and discuss student understanding or lack of understanding in light of how effective they thought they were as teachers in carrying out their plan (Hiebert & Stigler, 2000; Morris, 2006; Santagata et al., 2007). Instead, Anna focuses only on the students and provides specific examples of student behavior that provide evidence of student understanding or struggle. In both cases, her comments are directly linked to the lesson learning goal. This is also a difficult task for novice teachers because students do and say many things during a lesson, but to effectively analyze the lesson success, teachers need to attend to those behaviors that provide evidence of progress or difficulty toward the specific lesson goal.

5.3. Generating Hypotheses about Features of the Teacher's Instruction that Promoted Student Learning

Anna's collected evidence of student progress provides the basis for reasoning about the effectiveness of her instructional strategies. Anna describes in detail her instructional choices and explains how she collected evidence after each task to make sure she could move on to the next (see excerpts of her analysis on page 12).

The coherence of her reflections demonstrate that she entered the classroom with a clear goal and a defined path, collected evidence of student progress along the way, and was able to refer back to that evidence in reasoning about the effectiveness of her teaching.

5.4. Using Hypotheses to Propose Improvements in Teaching

The process of generating evidence-based hypothesis brings Anna to identify instances in which she could have collected better evidence of student learning. She critiques her strategies and proposes to include a challenge (i.e., create another prediction of rolls for the same set of numbers from 402 to 1,000) that would allow her to better assess student understanding. This search for additional evidence is particularly noteworthy in a novice.

5.5. Learning from Teaching

Overall, Anna's reflections demonstrate her disposition toward continuous improvement and her embracing of the idea that it is through the gathering of student evidence that one can assess the effectiveness of their teaching and plan

for improvements. At the end of math methods course, we administered a survey to all course participants. We asked how they know whether the lesson was successful. Anna replied:

> *Students from all levels show growth towards the learning goal. That the teacher has a good gauge of what the students learned or struggled with so they will know what their next steps are.*

This response confirms that Anna directly links the success of a lesson to the achievement of the lesson learning goal. In addition, her response clearly indicates that effective teaching includes the teacher's monitoring of student learning during instruction. Pre-service teachers were also asked to comment on what teachers can learn from their everyday teaching in the classroom. Anna responded:

> *Teachers can learn from everyday teaching by being in constant reflection of their practice. For example, at the end of a lesson, during breaks, or after school just taking a breather and thinking (or writing) about what worked and what didn't work and why and what could be done better for next time. Also, teachers could video tape themselves to take in all that is happening in the classroom to reflect or observe another teacher to gain more insight into various practices.*

Again it is evident that Anna conceives analysis and reflection as integral parts of a teacher job. She believes that the product of her reflection can help her plan for subsequent instruction. I argue that it is exactly through this process that teachers can continue to learn over time. At the end of each lesson, they can learn something about their students and about teaching. Anna reflects on what she has learned through teaching the lessons for the PACT:

> *Based on the experiences of this learning segment, I learned a lot about my students as mathematics learners. They were all able to easily create meaning of the manipulatives, which aided in their progress towards the learning objective.*
>
> *I also learned that many of my students are enthusiastic about math especially when the math involves sharing ideas and taking part in discourse.*
>
> *As a class, they are easily able to identify the parts of a given number in its simplest, most efficient representation with the least amount of hundreds, tens, and ones used. Some still did show struggle with showing a number in a second way requiring a strong understanding of number flexibility.*

Anna can now take these learnings into her next lesson plan and continue to build over time her knowledge of both her students and of the teaching process.

5.6. Video as a Tool for Facilitating the "Learning from Teaching" Process

Video played a key role in working with Anna.I will now step back from her case, to discuss more broadly the affordances that video created for all pre-service teachers involved in the "Learning to Learn from Mathematics Teaching" project, as well as issues that teacher educators may encounter. The most important function that video served was that of providing concrete images of teaching. This allowed for discussions of learning goals, evidence of student thinking, and effectiveness

of instructional strategies to be grounded in practice. The complexity of the work of teaching is maintained in video recordings, while the digital media facilitates the analysis process through the possibility of stopping the video at any point and reviewing particular segments. Class discussions grounded in practice are fruitful because it is through the confrontation of multiple perspectives that a deeper understanding of the teaching/learning process can be achieved. When using video for these purposes, issues teacher educators have to deal with involve technical aspects. Because the analysis of student learning is fundamental in this process, videos need to include close-up and clear images of student work and high-quality audio that capture students' soft voices.

A second important function that video served was that of providing images of teaching strategies that make student thinking visible. Through the process of systematic analysis pre-service learn about instructional strategies that create opportunities for students to express their thinking. Only when lessons generate evidence of student thinking, can teachers engage in the process of systematic analysis I have outlined in this article. This is extremely important to be able to transfer these analysis skills to the analysis of one own's teaching. In this case, issues that teacher educators face deal with choosing video that portrays strategies pre-service teachers should and can test in their own classroom. I have argued elsewhere (Santagata & Guarino, 2011) that the choice of video should balance the goal of modeling effective practices with the goal of modeling practices within the reach of novices. In other words, pre-service teachers should identify with the teacher in the video and feel assured that the teaching portrayed in the video does not belong to expert teaching only. The teacher educator task is to break down practices that seem quite complex at a first look, but become more approachable when its components are made evident. Finally, video provided feedback. Pre-service teachers were asked to videotape themselves and apply the four skills to the analysis of their own teaching. Because of the increasing availability of digital cameras (through iPhones, laptop computers, and iPads) videotaping has become quite easy to implement and experience with systematic analysis facilitates decisions about focus and zooming strategies.

6. Conclusions

Those who have worked in professional development settings in the U.S. know how challenging it is to change the U.S. cultural script for teaching mathematics from directed instruction, heavily focused on procedural knowledge, to student-centered teaching for understanding (Gallimore, 1996; Gallimore& Santagata, 2005). The video-enhanced analysis approach illustrated here may serve as a promising form of professional development for in-service teachers as well. In a prior project, my colleagues and I have documented both the benefits of this approach and the challenges in-service teachers may encounter (Santagata, Kersting, Givvin, & Stigler,

2011; Santagata, 2009). In particular, school settings sometimes constrain change rather than support it (Givvin & Santagata, 2011). Teacher preparation programs have to counter cultural practices and beliefs as well. Future teachers often bring to their programs beliefs and practices they have learned through the years as students in U.S. classrooms. The process of analysis outlined in this manuscript helps future teachers to unpack the teaching and learning process and to understand the important role they, as teachers, play for student learning. This process also opens the door to teaching possibilities that go well beyond the cultural script with which future teachers are familiar and allow them to try out and test innovative practices. The case discussed here provides some hope that changes are possible. Video is a promising tool for both providing images of innovative practices and for facilitating systematic reflections on a culturally-defined activity such as teaching. Of course, questions remain about the challenges Anna may encounter once she enters the teaching profession. Teachers' work in schools is often characterized by multiple constraints that make changes very difficult to implement. Innovative possibilities for supporting future teachers are offered by other authors of manuscripts included in this special issue. The project summarized here also includes a three-year longitudinal follow up of our graduates into their teaching jobs to shed light on forms of support Anna and her colleagues might need.

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Résumé

Vers un enseignement ambitieux : l'usage de la vidéo pour soutenir le développement du raisonnement des futurs enseignants au regard de preuves concernant l'apprentissage des élèves

RÉSUMÉ : L'idée de vision professionnelle tend à s'imposer dans le champ de la recherche sur l'enseignement aux USA. Elle repose sur la thèse selon laquelle les enseignants, tout comme les membres d'autres professions, construisent des modes spécifiques de raisonnement à propos de leur travail. La vision professionnelle a été définie initialement par Sherin (2007) en référence à deux processus mobilisés par les enseignants en salle de classe (phase active) : a) une attention particulière à des composantes essentielles de l'enseignement et b) un travail de délibération sur ces dimensions de façon à prendre des décisions éclairées. Récemment, l'idée de vision professionnelle s'est ouverte aux phases pré active (planification) et post active (réflexion sur l'action entreprise). Par ailleurs, une étude de Kersting, Givvin, Thompson, Santagata, et Stigler, (2012) soutient la thèse selon laquelle la capacité des enseignants à analyser des épisodes d'enseignement présentés sous la forme de clips vidéos et à proposer sur cette base, des modalités d'amélioration de leurs stratégies d'enseignement constitue un prédicteur de l'efficacité de leur pratique.

Dans cette perspective, l'auteure suggère que la capacité des futurs enseignants à analyser des épisodes d'enseignement mériterait d'être l'objet d'un entraînement systématique en formation initiale. Il s'agit de les préparer à apprendre à partir de leur expérience d'enseignement (*Learning from teaching*) selon l'expression introduite par Hierbert, Morris, Berk et Jansen (2007). Pour ce faire, 4 habiletés de base devraient être forgées, selon ces auteurs : 1) spécifier des objectifs d'apprentissage pour la leçon, 2) se donner les moyens de collecter des preuves relatives à l'apprentissage des élèves, 3) formuler des hypothèses sur les stratégies utilisées par l'enseignant pour susciter l'apprentissage des élèves et 4) reconsidérer son enseignement sur base de ces hypothèses.

L'auteure indique également combien cette démarche systématique d'analyse de l'enseignement s'inscrit particulièrement bien dans les projets politiques actuels aux USA de transformations des pratiques d'enseignement, et notamment d'enseignement des mathématiques. Il s'agit de mettre

en l'avant ce qui est désigné comme un enseignement audacieux des mathématiques. L'audace repose ici sur l'idée de mettre l'élève au cœur du processus d'enseignement-apprentissage des mathématiques et de l'engager dans des modes de pensée mathématique par le truchement de discussions sur le sens des idées mathématiques. Pour l'auteure, il est indispensable que les enseignants ayant à relever ce défi développent la capacité à a) analyser les processus de pensée mathématique dans lesquels s'engagent les élèves et b) apprécier les stratégies d'enseignement en mesure de contribuer à de tels apprentissages.

De façon générale, les recherches de l'auteure semblent soutenir la thèse selon laquelle un entraînement des futurs enseignants à exercer les quatre habiletés présentées ci-dessus, les conduit à adopter des stratégies d'enseignement en phase avec les préceptes d'un enseignement audacieux des mathématiques. De manière spécifique, la suite du texte discute : 1) le cadre pour l'analyse d'une leçon développé en référence aux 4 habiletés préalablement présentées que l'auteure utilise dans le cadre de la formation à l'enseignement, 2) les diverses façons dont la vidéo est utilisée afin de soutenir l'apprentissage de ces 4 habiletés et 3) une illustration de la démarche à l'aide du cas d'Anna, une enseignante en formation initiale, engagée dans une démarche d'analyse d'une leçon de mathématiques donnée préalablement en deuxième année du primaire.

L'auteure focalise une partie de la discussion du cas sur le rôle que joue la vidéoformation dans le développement et l'entraînement de cette capacité à analyser et réguler sa pratique d'enseignement. Cette discussion tourne autour de différents avantages de la vidéo dans l'entraînement de ces habiletés. L'auteure défend l'idée générale que le recours à la vidéo permet d'enraciner l'apprentissage à partir de l'expérience de l'enseignement dans la réalité concrète des pratiques de classe. Il importe néanmoins de prendre soin de sélectionner des exemples de pratiques accessibles aux novices.

Plus particulièrement, la présentation sous la forme de vidéo d'épisodes concrets d'enseignement offre l'opportunité d'ancrer la discussion des objectifs d'apprentissage, des processus d'apprentissage ou encore de l'efficacité des stratégies d'enseignement sur des observables. En outre, elle permet de restituer une partie de la complexité du travail enseignant tout en facilitant le travail d'analyse (arrêt sur image, retour en arrière, etc.). Par ailleurs, l'auteure souligne le potentiel de la vidéo dans la discussion d'épisodes d'enseignement en matière de multiplication des points de vue sur un même épisode. Enfin, la vidéo offre la possibilité de centrer l'analyse sur les processus de pensée mathématique déclenchés par l'enseignement chez les élèves ou encore de fournir un feed-back sur l'enseignement et le développement de la capacité d'analyse d'épisodes d'enseignement.

MOTS-CLÉS : formation initiale des enseignants, mathématiques, équipement audiovisuel